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Impact of improvements in volcanic implementation on atmospheric chemistry and climate in the GISS-E2 Model

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The representation of volcanic eruptions in climate models introduces some of the largest errors when evaluating historical simulations, partly due to the crude model parameterizations. We will show preliminary results from the Goddard Institute for Space Studies (GISS)-E2 model comparing traditional highly parameterized volcanic implementation (specified Aerosol Optical Depth, Effective Radius) to deploying the full aerosol microphysics module MATRIX and directly emitting SO_2 allowing us the prognosically determine the chemistry and climate impact. We show a reasonable match in aerosol optical depth, effective radius, and forcing between the full aerosol implementation and reconstructions/observations of the Mt. Pinatubo 1991 eruption, with a few areas as targets for future improvement. This allows us to investigate not only the climate impact of the injection of volcanic aerosols, but also influences on regional water vapor, O_3, and OH distributions.

With the skill of the MATRIX volcano implementation established, we explore (1) how the height of the injection column of SO_2 influence atmospheric chemistry and climate response, (2) how the initial condition of the atmosphere influences the climate and chemistry impact of the eruption with a particular focus on how ENSO and QBO and (3) how the coupled chemistry could mitigate the climate signal for much larger eruptions (i.e. the 1258 eruption, reconstructed to be $\sim$10x Pinatubo). During each sensitivity experiment we assess the impact on profiles of water vapor, O_3, and OH, and assess how the eruption impacts the budget of each.